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Vitellogenin RNAi treatment halts oocyte growth without decreasing protein translation

Organisms must allocate resources to either somatic storage or reproduction, yet the physiological mechanisms coordinating this trade-off are poorly understood. In the lubber grasshopper, vitellogenin (Vg) is the precursor protein to vitellin, which constitutes 90% of protein in mature oocytes. Previously, to investigate how investment into somatic storage is affected by reproductive protein resources, we utilized RNA interference (RNAi), reducing Vg-mRNA in the fat body 30-fold, however Vg protein in the hemolymph increased. Additionally, Vg-RNAi treatment halted ovarian growth and doubled fat body mass. In this study, we measured hemolymph levels of 90 kDa hexameric storage protein (Hex90), ovarian vitellin content, and rates of Vg production by the fat body. We compared Vg-RNAi treated individuals to the buffer-injected and Vg-RNAi groups combined ($P=0.04$). The Vg-RNAi group had significantly lower vitellin content per gram of ovary compared to buffer-injected ($P=0.006$), but not the Hex90-RNAi ($P=0.360$) group, indicating that Vg-RNAi treatment may prevent Vg from being sequestered into developing oocytes. In addition, rate of Vg production by the fat body was higher at 19 d than at 26 d ($P=0.002$) but was not affected by Vg-RNAi treatment ($P=0.383$). Together, these results suggest that Vg-RNAi treatment does not reduce the translation rate of Vg-mRNA, but nonetheless halts sequestration of Vg into developing oocytes and increases fat body mass, consistent with a trade-off between reproduction and storage.

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Flexible adjustments of internal organs in cold acclimated shorebirds

Seasonal cold acclimatization in the red knot (*Calidris canutus islandica*), a long distance migratory shorebird, has been shown to result mainly from adjustments in body mass. Since pectoral muscles are the largest shivering muscles in birds and because their size tracks variations in body mass, adjusting body mass to cold temperatures results in higher shivering heat production capacity (summit metabolic rate: Msum) and cold endurance. However, little is known on possible adjustments of other body components that may play an essential role in cold acclimatization. In this study we investigated the effects of thermal treatments on body composition, metabolic performance and tissue metabolic intensity of captive individuals maintained under constant cold (5°C) and constant thermoneutrality (25°C). As expected, preliminary results show that when controlling for body size cold acclimation is associated with a higher body mass and metabolic performance (basal metabolic rate: BMR and Msum). Dissection data also revealed significant increases (8–30%) in the mass of the intestines, stomach, liver, kidney, heart, flight muscles (pectoralis and supracoracoid), leg muscles and carcass (skeleton and other muscles). Enzyme analyses in muscles (pectoralis, leg, heart), kidney and liver highlighted no changes in lactate dehydrogenase (LDH), 3-hydroxyacyl-CoA dehydrogenase (HOAD) and citrate synthase (CS) but a significant increase in the activity of carnitine palmitoyl transferase (CPT) in pectoralis and leg muscles of cold acclimated individuals. These findings suggests that, in addition to flight muscles, most internal organs increase in size during cold acclimation and that an upregulation of fatty acid transport in mitochondria may be required to improve fuel delivery to support shivering in skeletal muscles.

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Linking manipulative experiments to field data to test the dilution effect

The dilution effect, the hypothesis that biodiversity reduces disease risk, has received support in some systems. However, few dilution effect studies have examined the effects of diversity on more than a single host species or have linked mechanistic experiments to field patterns to establish both causality and ecological relevance. We tested the dilution effect hypothesis in an amphibian–*Batrachochytrium dendrobatidis* (Bd) system. We show that tadpoles can filter feed Bd zoospores and that the degree of filter feeding was positively associated with their dilution potential. The obligate filter feeder, *G. carolinensis*, generally diluted the risk of chytridiomycosis for *B. terrestris* and *H. cinerea* tadpoles, whereas *B. terrestris*, an obligate benthos feeder, generally amplified infections for the other species, and species richness was a significant negative predictor of Bd abundance. Field data, at the scale of the entire United States, a scale to which the dilution effect has never been tested, corroborated these laboratory findings and were predictable based on host characteristics, providing hope that there are traits of hosts that can predict their diluting and amplifying capabilities.

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The Developmental Basis of Head Crests in the Domestic Pigeon

The domestic rock pigeon exhibits dramatic variation in a wide range of morphological traits, including plumage structures. We investigated the molecular and developmental basis of the head crest, a morphological trait characterized by a reversal in the direction of feather growth on the back of the head. These structures occur in many pigeon breeds, and similar structures are important in mate choice in wild bird species. Preliminary studies indicate that all crested domestic pigeons share a common single nucleotide variant. Furthermore, gene expression assays demonstrate that molecular polarity within the feather buds of the crest region has been reversed. This work provides new insights into feather development in the domestic pigeon, and can be used to help understand feather development and evolution in other avian species. In this presentation, we discuss the outcomes and protocols emerging from this work supported by the EDEN Research Coordination Network.